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EXAMINER
DOLAN, JENNIFER M

ART UNIT	PAPER NUMBER
2813	

DATE MAILED: 08/15/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/043,723	MAEKAWA ET AL.	
	Examiner	Art Unit	
	Jennifer M. Dolan	2813	

-- The MAILING DATE of this communication app ars on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 32-75 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 32-51,59-70 and 75 is/are rejected.

7)☒ Claim(s) 52-58 and 71-74 is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on 08 January 2002 is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____.
4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

As the claims are directed to a thin film transistor, per se, the method limitations appearing in lines 3-5 of claim 1, claims 37-40, 42, 43, 48, 50, and 51 in entirety, and lines 4-6 of claim 44, have only been accorded weight to the extent that they affect the structure of the completed TFT. Note that "determination of patentability in 'product-by-process' claims is based on product itself, even though such claims are limited and defined by process [i.e., "various annealing parameters, doping through transition metal windows of various sizes, doping using various processes"], and thus product in such claim is unpatentable if it is the same as, or obvious form, product of prior art, even if prior product was made by a different process", *In re Thorpe, et al.*, 227 USPQ 964 (CAFC 1985). Furthermore, note that a "product-by-process claim, although reciting subject matter of claim in terms of how it is made [i.e., "performing annealing with an RTA process" is still product claim; it is patentability of product claimed and not recited process steps that must be established, in spite of fact that claim may recite only process limitations", *In re Hirao and Sato*, 190 USPQ 685 (CCPA 1976). Note that for the purposes of examination, the limitation of

a forming transition metal window having various properties is only accorded weight to the extent that it determines the size or area of crystallized material, the recited annealing processes are only accorded weight to the extent that the amorphous film is converted to a single crystal film, and the specific doping processes are only accorded weight to the extent that they affect the profile of the metal dopant in the semiconductor material.

2. Claims 32, 34-41, 46, 47-49, 51, 59-61, 63-66, 69, 70, and 75 are rejected under 35 U.S.C. 102(e) as being anticipated by U.S. Patent No. 5,888,857 to Zhang et al.

Regarding claims 1 and 37-40 Zhang discloses a first TFT (figures 1c and 6c) comprising source/drain and channel regions of a single grain of crystallized first film material (figures 1b, 1c, 6a-6c) formed from doping an amorphous first film (1) with a transition metal (column 12, lines 1-30) and annealing to form a first area of crystallized first film (column 12, lines 17-30; figure 1b) which is a single grain, and etching a pattern in the first area of crystallized first film to for the source/drain regions (column 13, lines 1-3; figures 2c-2d; 6a-6b; 9a-9c), whereby a transistor is formed having a high electron mobility and low leakage current in the active areas (column 9, lines 15-30; column 18, lines 20-25).

Regarding claim 61, Zhang discloses a TFT, comprising: a film of semiconductor material (1) formed on a transparent substrate (1A; column 11, lines 50-53), the semiconductor material including a first area (3, figure 1b) in which the semiconductor material is crystallized around selected transition metal nucleation sites (2; figures 1a-1c); source/drain and channel regions formed I the first area (figure 1c; figures 2c-d; 6a-b; 9a-c); and the distance between transition metal nucleation sites is no less than 2 microns (column 12, lines 5-9), whereby a

transistor is formed having a high electron mobility and low leakage current in the transistor active areas (column 9, lines 15-30; column 18, lines 20-25).

Regarding claims 34 and 63, Zhang discloses a gate oxide layer (12) overlying the channel region (figure 3a); and a gate electrode (13a) overlying the gate oxide layer (figures 3a-3c), whereby a top gate TFT is fabricated.

Regarding claims 35 and 64, Zhang discloses that the first film material is silicon (column 11, lines 52-54).

Regarding claims 36 and 65, Zhang discloses that the transition metal is nickel (column 12, lines 5-30).

Regarding claims 41 and 66, Zhang discloses that the transition metal-semiconductor compound surrounding the first area of crystallized first film is removed when the source/drain regions are defined, whereby the crystallized film is cleaned of materials which promote high leakage current (column 12, line 37-column 13, line 5; column 14, lines 25-34).

Regarding claims 46 and 69, Zhang discloses that the separation between nucleus sites is about 5-50 microns (column 12, lines 5-8; see figures 1a-1c), which leads to a density of nucleus sites of about $4 \times 10^4 - 4 \times 10^6 /cm^2$, which is less than the claimed upper bound.

Regarding claim 47, Zhang discloses that the distance between nucleus sites is from 5-50 microns (column 12, lines 5-8), which is 'no less than 2 microns.'

Regarding claim 48, Zhang discloses that the crystallized film area is only slightly larger than the transition metal window area, thus making the ratio 1: a number slightly larger than 1 (see Zhang, column 16, lines 30-40).

Regarding claims 49 and 70, Zhang discloses that the first area of crystallized first film has a radius approximately equal to half of the nucleation site separation distance (figure 1b), which leads to an area of about 300 square microns (using a separation of 20 microns; column 12, lines 7-8).

Regarding claim 51, Zhang discloses that the transition metal doping occurs simultaneously with the annealing of the first film (column 12, lines 18-30).

Regarding claim 59, Zhang discloses a glass substrate (column 11, lines 51-52), where the crystallized first film is formed overlying the substrate (figures 1a-1c).

Regarding claims 60 and 75, Zhang discloses that the amorphous first film has a thickness from 500-1500 angstroms (column 11, lines 52-56).

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 42-44 and 67 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zhang et al.

Zhang teaches the concept of restricting the area into which the transition metal is doped (i.e., a transition metal window; see Zhang, 4th- 7th embodiments; column 15, lines 21-45; column 17, lines 18-32); Zhang additionally shows a second TFT formed adjoining the first TFT,

in which at least a second area of crystallized first film is formed adjoining the first area (figures 1a-1c). Zhang fails, however, to specify the exact size of the doping window.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to specify a doping window having a width in the range of 20-50 microns and a length in the range of 60-150 microns. The rationale is as follows: One of ordinary skill in the art at the time the invention was made would have been motivated to specify a doping window in the ranges given, because Zhang shows an embodiment in which it is only desirable to crystallize the peripheral circuit region, while retaining polysilicon TFTs in the active matrix region (see column 9, lines 21-40). Since each individual device could be expected to be approximately in the range from 5-50 microns in length, and since the crystalline region will extend slightly beyond the doping window (see figures 7 and 9; column 16, lines 20-36), a doping window in the ranges specified would have been obvious for recrystallizing several peripheral devices while preventing the crystal growth from spreading into the active matrix.

5. Claims 45, 50, and 68 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zhang et al. in view of U.S. Patent No. 5,744,822 to Takayama et al.

Regarding claims 45 and 68, Zhang fails to specify the concentration of the transition metal.

Takayama discloses that the transition metal concentration needs to be about $5 \times 10^{18}/cm^3$ in order to promote lateral crystallization and allow for a lower anneal temperature (column 3, lines 54-64).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to specify that the transition metal concentration of Zhang is about 5 x $10^{18}/cm^3$, as taught by Takayama. The rationale is as follows: One of ordinary skill in the art at the time the invention was made would have been motivated to provide a concentration as specified, because doing so allows for the easy recrystallization of the amorphous semiconductor material, such that the crystallization time is short and anneal temperature is low (see Takayama, column 3, lines 54-64).

Regarding claim 50, Zhang fails to teach the use of CVD or ion implantation methods.

Takayama discloses that the transition metal can equivalently be provided by ion implantation, or by depositing the metal on the surface of the amorphous film (see column 6), and then annealing.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the doping procedure of Zhang, such that it comprises ion implantation, as taught by Takayama. The rationale is as follows: One of ordinary skill in the art at the time the invention was made would have been motivated to use ion implantation, because Takayama shows that both the method of depositing metal nucleation sites on the surface of an amorphous film, and then annealing (as in Zhang), and the method of ion implantation can be equivalently and alternately used to distribute the transition metal to the amorphous film for crystallization (see Takayama, column 6 and examples 4 and 6).

6. Claims 33 and 62 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zhang et al. (hereafter Zhang '857) in view of U.S. Patent No. 5,595,944 to Zhang et al. (Zhang '944).

Zhang '857 fails to disclose a bottom gate TFT.

Zhang '944 discloses a TFT using a nickel-implanted recrystallized layer in a bottom gate TFT (figures 1A-1E) comprising a gate electrode (2); a gate oxide (3), where the gate electrode and gate oxide are deposited before the first film (5).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the TFT of Zhang '857 such that it comprises bottom gate TFTs, as suggested by Zhang '944. The rationale is as follows: One of ordinary skill in the art at the time the invention was made would have been motivated to provide a bottom gate TFT, because both top gate and bottom gate TFTs are well known in the art, and the use of either would be suggested to one skilled in the art. Zhang '944 further shows that transition metal catalytic recrystallization can easily and equivalently be applied to both bottom gate (figure 1) and top gate (figures 2 and 3) TFTs.

Allowable Subject Matter

7. Claims 52-58 and 71-74 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

8. The following is a statement of reasons for the indication of allowable subject matter: The prior art of record, considered as a whole, fails to teach or suggest doping a transition metal into an amorphous film of a TFT by depositing an insulating film over the amorphous film,

depositing a transition metal over the insulating film, and then diffusing the transition metal through the insulating film, in addition to the other limitations in the claims. The relevant art of record, such as Zhang '857, teaches the deposition of the transition metal directly on the amorphous film. The addition of an insulating layer improves upon the prior art of record by allowing for greater controllability of nucleation.

Conclusion

9. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

a. U.S. Patent No. 5,804,473 to Takizawa discloses methods for using transition metals to convert an amorphous film into a polycrystalline film.

b. U.S. Patent No. 5,637,515 to Takemura discloses a TFT formed with a single crystal grain boundary in the channel region.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jennifer M. Dolan whose telephone number is (703) 305-3233. The examiner can normally be reached on Monday-Friday 8:30am-5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl W. Whitehead, Jr. can be reached on (703) 308-4940. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9318 for regular communications and (703) 872-9319 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

Jennifer M. Dolan
Examiner
Art Unit 2813

jmd
August 8, 2003

SUPERVISORY PRIMARY EXAMINER
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